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Documentation of IANA Assignments for Label Distribution Protocol (LDP), Resource ReSerVation Protocol (RSVP), and Resource ReSerVation Protocol-Traffic Engineering (RSVP-TE) Extensions for Optical UNI Signaling

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Abstract

The Optical Interworking Forum (OIF) has defined extensions to the Label Distribution Protocol (LDP) and the Resource ReSerVation Protocol (RSVP) for optical User Network Interface (UNI) signaling. These extensions consist of a set of new data objects and error codes. This document describes these extensions.

1. Introduction

The OIF UNI signaling specification is described in [8]. This specification utilizes IETF protocol standards as well as IETF work in progress. Specifically, the following IETF specifications are used:

- o Label distribution protocol (LDP) [6]
- o Resource reservation protocol (RSVP) [5]
- o GMPLS signaling and GMPLS extensions for SONET/SDH [4]
- o GMPLS RSVP-TE and CR-LDP extensions [2, 3]

The aim of the OIF UNI specification is the maximal re-use of IETF protocol definitions. A few extensions to IETF protocols, however, have been defined to serve UNI-specific needs. These extensions are described in this document.

2. LDP Extensions for UNI Signaling

The LDP extensions for UNI signaling consist of new TLVs that capture UNI-specific parameters and new UNI-specific status codes. The new TLVs are Source ID (3 TLVs), Destination ID (3 TLVs), Egress Label, Local Connection ID, Diversity, Contract ID, and UNI Service Level [8]. These are described below. The new status codes are assigned from the private use space of LDP codes, as described in [8]. The UNI specification [8] also defines two new LDP messages, Status Enquiry and Status Response. These messages have been obsoleted and hence no code points are requested in this document for them.

2.1 Source ID TLVs

Three TLVs have been defined to encode the Source ID. The content and usage of these TLVs are described in [8].

2.1.1 IPv4 Source ID

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|U|F|Source ID Type (0x0960)    |      Length                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
~                           Contents                            ~
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

2.1.2 IPv6 Source ID

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|U|F|Source ID Type (0x0961)    |      Length                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
~                           Contents                            ~
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

2.1.3 NSAP Source ID

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |U|F|Source ID Type (0x0962)    |      Length                   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                                                               |
   ~                       Contents                                ~
   |                                                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

2.2 Destination ID TLVs

Three TLVs have been defined to encode the Destination ID. The content and usage of these TLVs are described in [8].

2.2.1 IPv4 Destination ID

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |U|F|Dest ID Type (0x0963)      |      Length                   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                                                               |
   ~                       Contents                                ~
   |                                                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

2.2.2 IPv6 Destination ID

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |U|F|Dest ID Type (0x0964)      |      Length                   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                                                               |
   ~                       Contents                                ~
   |                                                               |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

2.2.3 NSAP Destination ID

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|U|F|Dest  ID Type (0x0965)     |      Length                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
~                       Contents                                ~
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

2.3 Egress Label TLV

The Egress Label TLV is encoded as:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|U|F|Egress Label (0x966)       |        Length                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
~                       Contents                                ~
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The content and usage of this TLV are described in [8].

2.4 Local Connection ID TLV

The Local Connection ID TLV is encoded as:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|U|F|Local Conn. ID (0x967)     |        Length                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
~                       Contents                                ~
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The content and usage of this TLV are described in [8].

2.5 Diversity TLV

The Diversity TLV is encoded as:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|U|F|Diversity (0x968)          |        Length                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
~                           Contents                            ~
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The content and usage of this TLV are described in [8].

2.6 Contract ID TLV

The Contract ID TLV is encoded as:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|U|F|Contract ID (0x969)        |        Length                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
~                           Contents                            ~
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The content and usage of this TLV are described in [8].

2.7 UNI Service Level TLV

The UNI Service Level TLV is encoded as:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|U|F|Service Level (0x970)      |        Length                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
~                           Contents                            ~
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The content and usage of this TLV are described in [8].

3. RSVP Extensions for UNI Signaling

A single new object class, called "Generalized_UNI" is defined. In addition, extension to the RSVP session object and new UNI-specific error codes are defined. These are described below.

3.1 Generalized_UNI Object

The GENERALIZED_UNI object has the following format:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       Length (>8)             | CNum(229)     |  C-Type (1)   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                         (Subobjects)                        //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Subobjects:

The contents of a GENERALIZED_UNI object are a series of variable-length data items. The common format of the sub-objects is shown below:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       Length                  |    Type       |  Sub-Type     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
//                              Value                          //
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The following sub-objects are defined. The contents of these sub-objects are described in [8]:

- Source Transport Network Assigned (TNA) Address sub-object: Type = 1. The following sub-types are defined:

  Ipv4 (Sub-type = 1);
  Ipv6 (Sub-type = 2);
  NSAP (Sub-type = 3).

  - Destination TNA Address sub-object: Type = 2; The following sub-types are defined:

    Ipv4 (Sub-type = 1);
    Ipv6 (Sub-type = 2);
    NSAP (Sub-type = 3).

- Diversity sub-object: Type = 3, Sub-type = 1.
- Egress label sub-object: Type = 4, Sub-type = 1.
- Service level sub-object: Type = 5, Sub-type = 1.

3.2 UNI_Ipv4_Session Object

This object [7] has the following format:

UNI_IPv4_SESSION object: Class = 1, C-Type = 11

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       Length (16)             | Class-Num(1)  |C-Type (11)    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          IPv4 Address                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       MUST be zero            |      Tunnel ID                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   Extended IPv4 Address                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The C-Type value (11) will distinguish UNI-related RSVP Sessions from other RSVP sessions. The usage of this object is described in [8].

3.3 Error Codes

UNI-specific errors fall under the "Routing Problem" (error code = 24) [7] and "Policy Control Failure" (error code = 2) [5] errors, and they require the assignment of sub-codes. The following is the list of errors and proposed assignments of sub-codes:

- Routing Problem: Diversity not available (Error code = 24, sub-code = 100)
- Routing Problem: Service level not available (Error code = 24, sub-code = 101)
- Routing problem: Invalid/Unknown connection ID (Error code = 24, sub-code = 102)
- Policy control failure: Unauthorized sender (Error code = 2, sub-code = 100)
- Policy control failure: Unauthorized receiver (Error code = 2, sub-code = 101)

4. IANA Considerations

The OIF UNI 1.0 specification defines new objects and error codes under LDP and RSVP. The majority of these extensions require code point assignments via IETF consensus action. These are summarized below.

4.1 LDP Messages, TLVs and Status Codes

TLV types 0x0960 - 0x0970 as described in Sections 2.1 - 2.7 above.

UNI-specific status codes have been allocated out of the Private Use space, i.e., 0x3Fxxxxxx. These do not require IANA administration.

4.2 RSVP Object Class and Error Codes

Generalized_UNI object class (Section 3.1), Class Number 229, C-Type 1. Further sub-objects are defined, with Type numbers 1-5 and various Sub-Type numbers, as described in Section 3.1. The code points for the Generalized_UNI object and the associated sub-objects require IANA administration.

UNI_Ipv4_Session Object (Class-Num = 1, C-Type = 11), as described in Section 3.2.

UNI-specific errors fall under the Routing Problem and Policy Control Failure errors (error codes 24 and 2). Sub-codes under error code 24 are 100, 101 and 102, as described in Section 3.3. Sub-codes under error code 2 are 100 and 101, as described in Section 3.3.

5. Security Considerations

Security considerations related to RSVP, RSVP-TE and LDP are described in Section 2.8, Section 6 and Section 5 of RFCs 2205 [5], 3209 [9] and 3036 [6], respectively. Security considerations pertaining to UNI signaling using the extensions described in this document and how these relate to the security aspects of RSVP, RSVP-TE and LDP are described in Section 13.4 of the UNI specification [8].

6. References

[1] Berger, L., Editor, "Generalized Multi-Protocol Label Switching (MPLS) Signaling Functional Description", RFC 3471, January 2003.

[2] Berger, L., Editor, "Generalized Multi-Protocol Label Switching (MPLS) Signaling Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Extensions", RFC 3473, January 2003.

[3] Ashwood-Smith, P. and L. Berger, Editors, "Generalized Multi-Protocol Label Switching (MPLS) Signaling Constraint-based Routed Label Distribution Protocol (CR-LDP) Extensions", RFC 3472, January 2003.

[4] E. Mannie, et al., "GMPLS Extensions for SONET and SDH Control", Work in Progress.

[5] Braden, R., Editor, Zhang, L., Berson, S., Herzog, S. and S. Jamin, "RSVP Functional Specification", RFC 2205, September 1997.

[6] Andersson, L., Doolan, P., Feldman, N., Fredette, A. and B. Thomas, "LDP Specification", RFC 3036, January 2001.

[7] Awduche, D., Berger, L., Gan, D., Li, T., Srinivasan, V. and G. Swallow, "RSVP-TE: Extensions to RSVP for LSP Tunnels", RFC 3209, December 2001.

[8] UNI 1.0 Signaling Specification, The Optical Internetworking Forum, http://www.oiforum.com/public/UNI_1.0_ia.html

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